

HUMIDOS

Low-pressure atomising humidifier



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Weidmann, Tenant Hostpoint

HUMIDOS

Air humidification is one of the basic types of air treatment. There are various procedures to do this. Humidification using a contact humidification process is traditional and no longer contemporary. Humidifying the air (supply air flow) using honeycomb humidification units no longer meets today's hygiene standards. Honeycomb humidification units are still being considered for adiabatic exhaust air humidification. However, the maintenance of these systems is relatively high and people are increasingly moving away from this type of humidifier.

A second method is air humidification with steam. Hygienically favourable and without temperature losses. During humidification, this process is again very energy-intensive. Steam must be produced (> 100 °C) and this requires a large amount of electrical energy. If steam is already present in a process chain, this method is very suitable and can be easily implemented.

The third method is air humidification using atomising humidifiers. This procedure is very contemporary and is often used. Standards have developed enormously and durability has improved significantly. Many older models were replaced due to their lack of functional reliability. Osmosis water is required for this type of humidifier. A booster pump (osmosis system) conveys the treated water to a higher level, where it is transferred into the air flow through atomiser nozzles. A water mist is created, which humidifies the dry air to the desired saturation level. The higher the saturation limit, the longer the required humidifier length.



Merck Sigma Aldrich, Buchs SG laboratory

Field of application

Humidos low-pressure atomising humidifiers can be used in both supply air and exhaust air ventilation units. When used as a supply air humidifier, the aim is to achieve optimum humidity for laboratories, clean rooms, production areas, offices, conference rooms and much more. The supply air humidity should be reliably maintained within a narrow band, regardless of the air volume. The operating time is then mainly in the winter months when cold outside air with low absolute humidity is treated and blown in.

If the atomising humidifiers are used as exhaust air humidifiers, the aim is to recover cooling in summer in conjunction with a CCS HR system. Exhaust air humidifiers are to a certain extent dry coolers for the glycol circuit or are used directly as dry coolers for cooling systems. Humidos humidifiers can also be used as exhaust air humidifiers together with a plate heat exchanger or a rotary HR. The correct material selection of the components must be observed in all cases (increased material requirements).

Functional description

Mountair Humidos low-pressure atomising humidifier without internal booster pump

The low-pressure atomiser is built as a stand-alone system without its own booster pump. The humidifier is fed from a water treatment/osmosis system with an integrated booster pump. Exactly 4–5 bar flow pressure is required at the humidifier inlet (supply). The supply is connected to the valve block with the zone and drain valves on the outside of the Monobloc. The zone-dependent water distribution system is installed from the valve block to the humidifier based on the project-specific design. The chrome steel nozzle rack with the low-pressure atomiser nozzles is installed in the humidifier interior.

The Humidos low-pressure humidifiers can be designed as 3-7-15 or 31-stage humidifiers. The zone valves are defined depending on the air volume flow, humidification level and system cross-section. For example, 4 zone valves (A/B/C/D) = 15 stages.

If the humidifier is switched off, the external drain valve is activated and the nozzle rack installed in the air flow can empty (hygiene regulation). Each Humidos low-pressure humidifier has its own control unit (control cabinet, mounted on the outside of the Monobloc and wired internally with zone and drain valves). The humididos control is controlled from the higher-level Monobloc controller with a Release and 0–10 V signal (control system/building automation). Internal power regulation is not carried out, the humidifier follows the signal given externally (8V = 80% humidifier output based on the maximum dimensions).

Humidifier nozzle rack

- Hygienic, all V2A, welded
- Divided in stages (2/3/4/5-zone valves)
- Turbulence generator
- Post-evaporation honeycomb structure
- Fully drainable

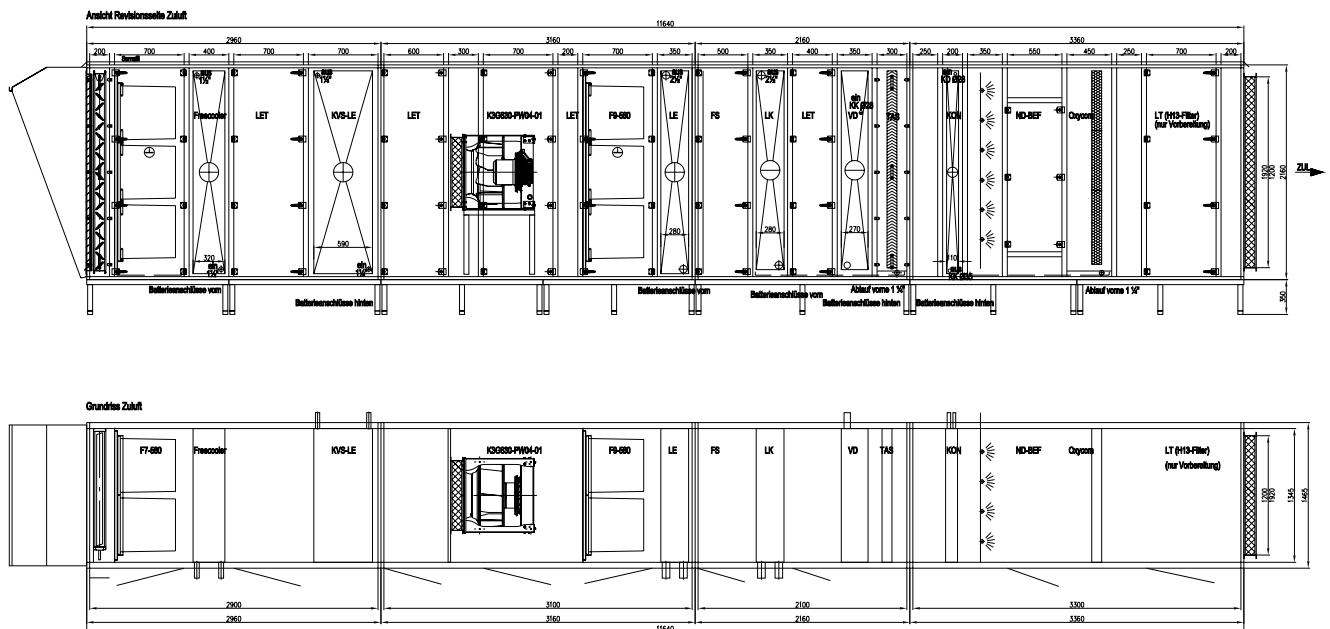
The humidifier rack is important. It generates turbulence and is attached to the wall (not placed in the tank) so that cleaning is easy. The nozzle block is divided into several stages. This is a Mountair solution tailored to your needs.



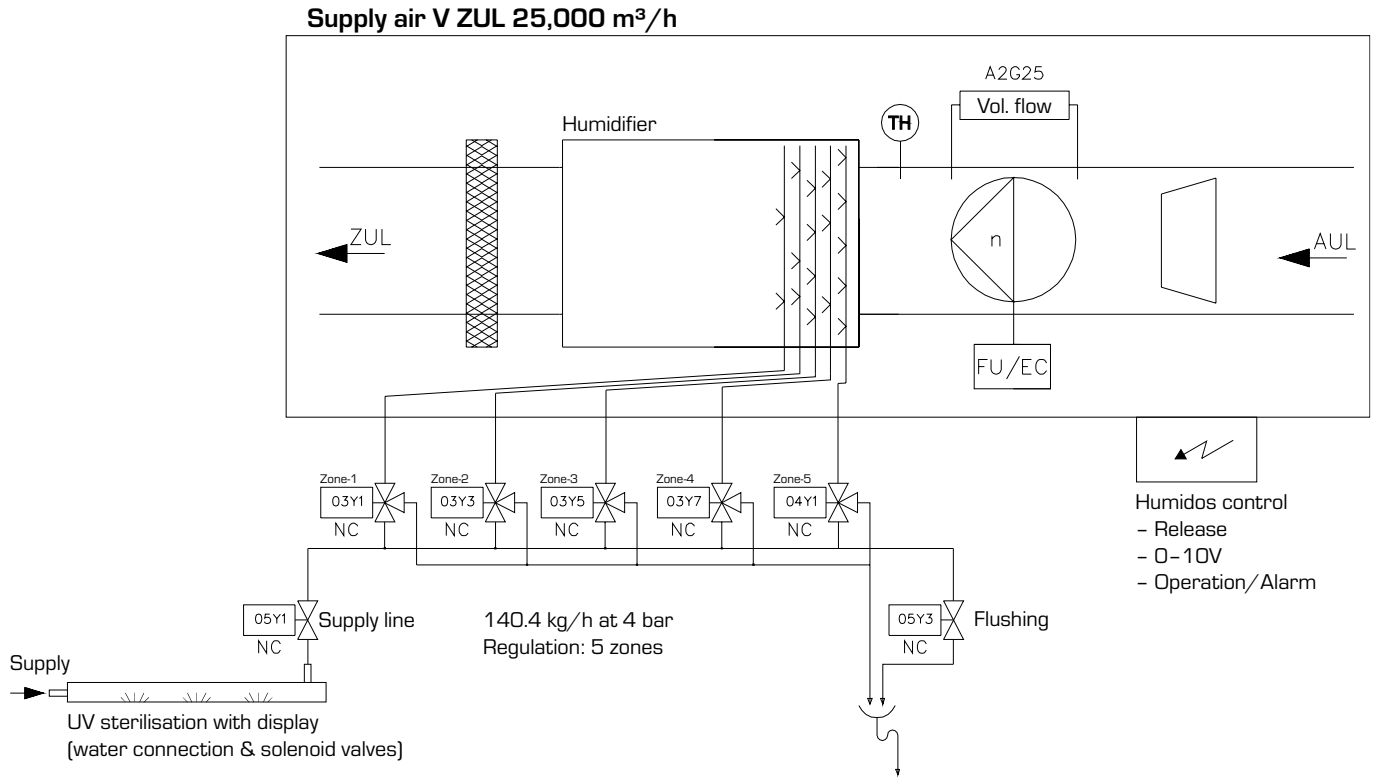
Palais de Rumine

Monobloc design

The Mountair HUMIDOS low-pressure humidifier is used in ventilation and air conditioning systems, regardless of the manufacturer of the system. When selecting the position in the ventilation and air conditioning unit, ensure that none of the downstream system components are exposed to excessive humidity; positioning at the end of the internal air flow is ideal (after the ventilator in the overpressure, after filter stages, no damp filters and therefore increased air-side pressure loss).



Schematic diagram

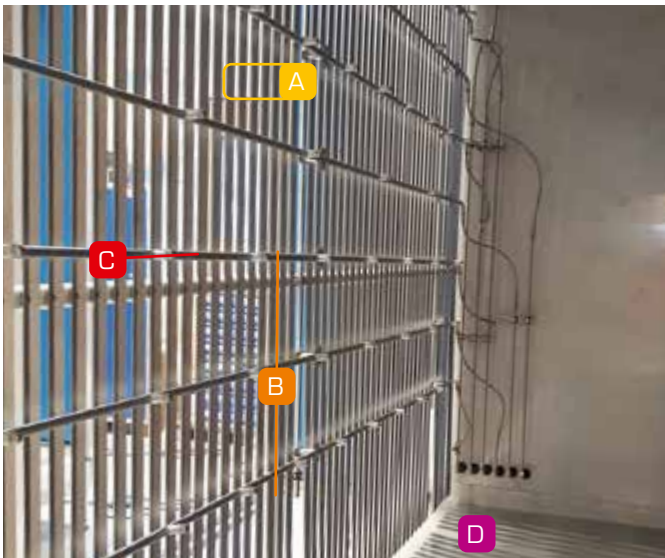


Options:

- UV sterilisation
- Hygiene function/flushing
- Humidification limitation according to current temperature; air humidity and air volume
- Interface – Modbus TCP/RTU, Bacnet

Components

Atomiser nozzle holder installed in the HVAC unit



Legends:

- A** Atomiser nozzle with the filter element
- B** Nozzle tube
- C** Cross-member
- D** Tray with drain

Low pressure atomiser nozzles



Various nozzle sizes are available. The definition is given by Mountair on a project and system-specific basis and is created in the form of a nozzle pattern and submitted to the customer.

Available nozzle sizes are:

1.00, 1.50, 2.45, 3.00, 4.30, 5.10, 6.40, 7.40, 9.50, 11.00, 12.20, 13.80, 16 kg/h

The nozzle selection is designed accordingly so that the humidifier can be operated ideally over several stages depending on the air volume and humidifier volume.

Zone valves



Humidos low-pressure humidifiers can be designed with different numbers of zone valves.

- 2 Zone valves = 3-stage
- 3 Zone valves = 7-stage
- 4 Zone valves = 15-stage
- 5 Zone valves = 31-stage

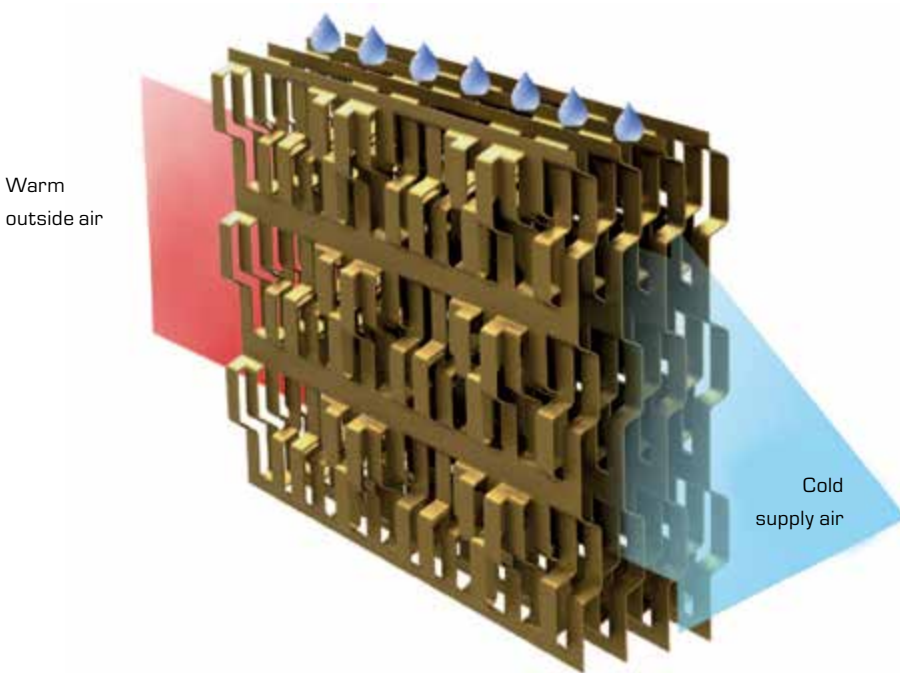
Components

Post-evaporation honeycomb design pad (Oxicom Oxyvap®)



The post-evaporation honeycomb design pads ensure optimum humidification and humidification distribution. Due to their very large surface area, the atomised fine water particles are absorbed within the honeycomb design pads and can be better absorbed by the air flowing through, as they remain in the honeycomb design for longer (more time).

The media consist of non-organic hydro-chill aluminium fins with an anti-corrosion coating. The hydro-chill fin technology is a combination of a special fin structure and a thin water-repellent coating designed to keep pressure drop at the minimum. In addition, the permanent antibacterial and antimicrobial coating reduces microbial activity by 99.99 % throughout its entire service life.



Features

- Saltwater-resistant aluminium fin plates with corrosion protection coating
- Hydrophilic and hygroscopic water-repellent coating
- Permanent antibacterial coating
- All-round modular and self-supporting frame
- Integrated inorganic water distribution and collection tray
- Minimal maintenance thanks to the vertical fin structure
- VDI 6022 hygiene certificate

Components

Optional UV lamp in supply line



Included in the UVpro EWR water treatment systems are:

- Stainless steel reactor V2A (1.4301)
- Cladding tube
- Flap closure
- UVC tube
- Electronics with monitoring display
- Safety goggles
- Cloth gloves
- Type 12 plug (pre-assembled)

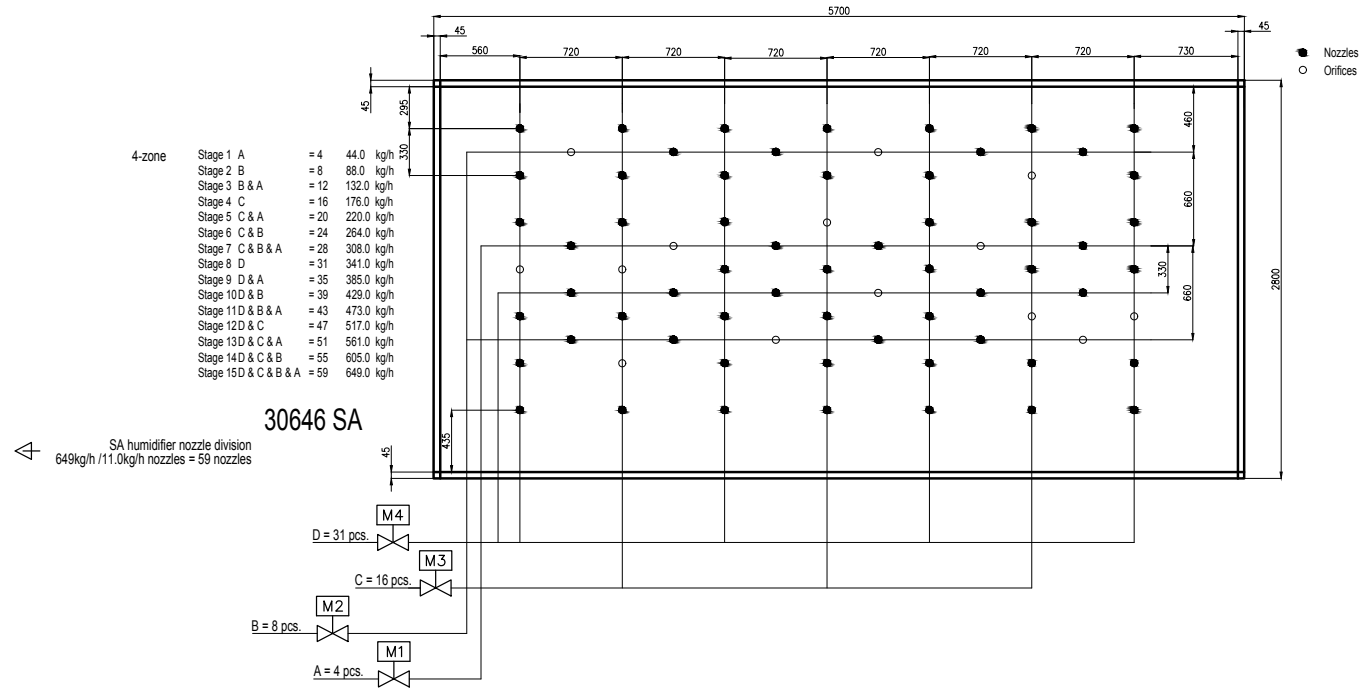
UV sterilisation: Low-pressure humidifier feed

Type	UVpro EWR L41
Output	49 W
Voltage	230 V

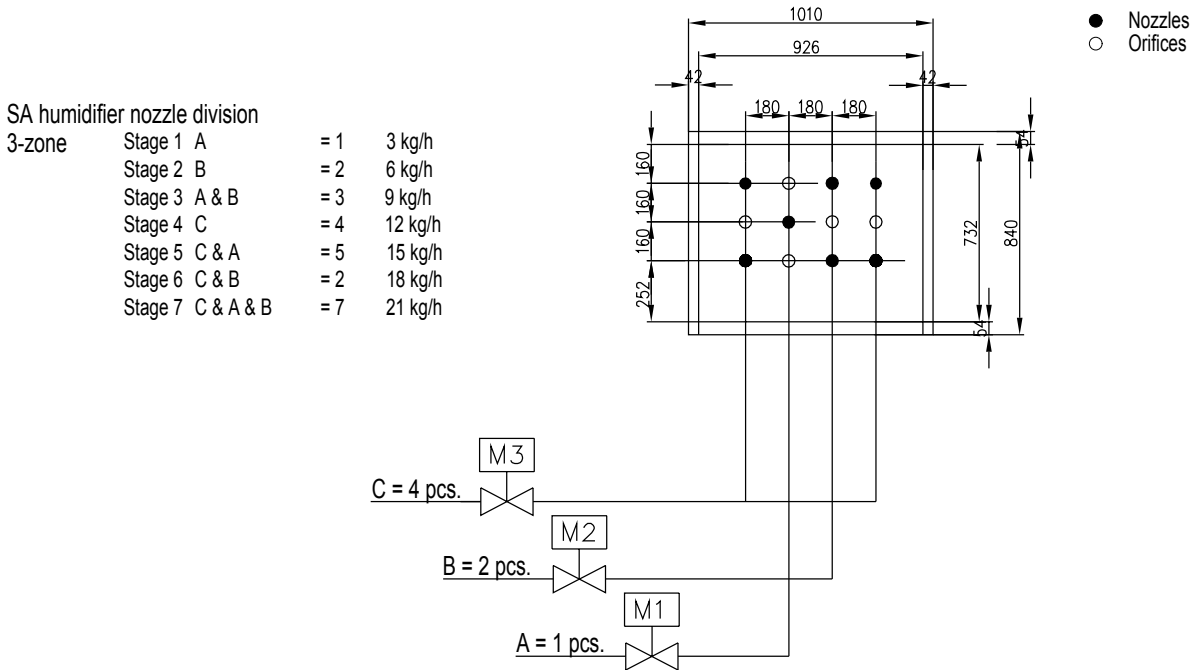


Humidifier racks

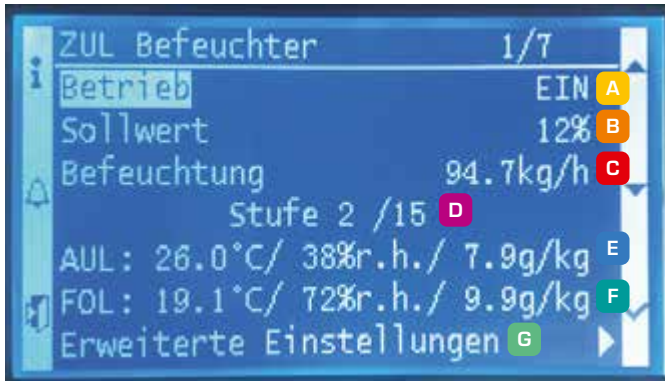
Nozzle pattern low pressure



Nozzle arrangement



Regulation



Legends:

- A** Externally activated
- B** Current power
- C** Current humidification
- D** Current power level
- E** Outside air temperature and humidity
- F** Supply air temperature and humidity
- G** Advanced settings



Regulation of output calculation

Current output level calculation

The humidifier operates in 15 output levels, for example. The current output level is calculated using the input signal (0–10 V) according to the following table. Individual levels can be changed via the HMI panel. The input signal is controlled by the time filter. The default value is 5 seconds.

The following table shows the output levels of a 15-level humidifier.

Level	Control voltage (V)	
	Out	Ein
1	≤ 0.6	≥ 1.0
2	≤ 1.2	≥ 1.6
3	≤ 1.8	≥ 2.2
4	≤ 2.4	≥ 2.8
5	≤ 3.0	≥ 3.4
6	≤ 3.6	≥ 4.0
7	≤ 4.2	≥ 4.6
8	≤ 4.8	≥ 5.2
9	≤ 5.4	≥ 5.8
10	≤ 6.0	≥ 6.4
11	≤ 6.6	≥ 7.0
12	≤ 7.2	≥ 7.6
13	≤ 7.8	≥ 8.2
14	≤ 8.4	≥ 8.8
15	≤ 9.0	≥ 9.4

Calculation of the valve position

The humidifier has four pipes with spray nozzles. Each line has a valve (A, B, C, D). The current position of each valve is selected according to the following table for the current output level.

Level	Valve A	Valve B	Valve C	Valve D	Active nozzles	Humidity (kg/h)
1	On	Off	Off	Off	-	
2	Off	Off	Off	On	-	
3	On	Off	Off	On	-	
4	Off	On	Off	Off	-	
5	On	On	Off	Off	-	
6	Off	On	Off	On	-	
7	On	On	Off	On	-	
8	Off	Off	On	Off	-	
9	On	Off	On	Off	-	
10	Off	Off	On	On	-	
11	On	Off	On	On	-	
12	Off	On	On	Off	-	
13	On	On	On	Off	-	
14	Off	On	On	On	-	
15	On	On	On	On	-	

The current output of the humidifier is calculated from the next function. The correct value for maximum humidification must be set for this function.

$$H = \frac{H_{\max}}{N_A + N_B + N_C + N_D} \times (A \times N_A + B \times N_B + C \times N_C + D \times N_D)$$

- H Current humidification
- H_{\max} Maximum humidification
- N_A Number of nozzles in line "A"
- N_B Number of nozzles in line "B"
- N_C Number of nozzles in line "C"
- N_D Number of nozzles in line "D"
- A Current operating status of the valve in line "A" (open = 1, closed = 0)
- B Current operating status of the valve in line "B" (open = 1, closed = 0)
- C Current operating status of the valve in line "C" (open = 1, closed = 0)
- D Current operating status of the valve in line "D" (open = 1, closed = 0)

Regulation functions

Integration of UV lamp

UV pro EWR stainless steel water reactors are reliable and easy to integrate sterilisation systems for the safe sterilisation of industrial and drinking water. Different device types are used depending on the humidifier output (water flow rate).

Device type	UVpro EWR L12	UVpro EWR L22	UVpro EWR L41	UVpro EWR L57	UVpro EWR L79
max. Water flow rate	700 525	1400 1050	2500 1875	3400 2550	4800 3600
Thread size [NPT]	½"	¾"	¾"	1"	1"
Electric power consumption, emitter [W]	15	22	39	50	45
Electric power consumption, total [W]	20	30	49	62	51

Humidification limitation using T/H and V sensor

Humidos humidifiers offer the option of limiting the humidification output as a safety function and independently of the external control signal. In this way, excess water can be minimised – even in the event of faulty control.

A maximum humidifier output is calculated based on the current temperature and humidity (wet bulb temperature) and the air volume.

The sensors required for this must be determined and planned in advance.

Flush function, hygienic system flush

Humidos low-pressure humidifiers work with osmosis water (demineralised water). The atomiser nozzles of the low-pressure humidifier operate at a flow pressure of 4 to 5 bar. The low-pressure humidifier does not have its own pumping station. The outlet feed pressure of the reverse osmosis system (RO) at the feed inlet of the low-pressure humidifier must be planned accordingly and set during commissioning.

The Humidos humidifiers are supplied with the required atomiser nozzle flow pressure of 4 to 5 bar directly from the reverse osmosis system (RO).

To ensure perfect hygiene when switched off, the Humidos humidifier has a (hygiene) flushing function. The humidifier nozzle racks are always emptied after switching off the humidifier using a 3-way solenoid valve (see layout diagram). The residual water in the nozzle pipes flows out slowly through the solenoid valves opened in the direction of the drain; there is no residual water inside the Monobloc or inside the atomising humidifier.

In the supply lines to the humidifiers, however, there is standing water in the pipes/hoses. These feed lines can be flushed using the flushing function of the Humidos humidifier. There are two parameters for this in the control menu that can be set user-specifically:

- A) Flushing interval
- B) Duration of flushing

The flush function is active as soon as the humidifier has no operating request (no release). The first flush is carried out after the entered interval time (default value: 14 days). The flushing duration can be set depending on the line length and configuration (default value: 5 min.).

Design examples

Winter, supply air humidification

Air heater								
Manufacturer	Mountair	Air inlet	10.7 °C	Medium Water	Number of tube rows	2 RR	Accessories	12
Type	AIRSOL®	1.4 g/kg	17 %r.H.	Flow temperature	60 °C	Pipe volume	15 l	
		Air outlet	30.0 °C	Return temperature	40 °C	Supply Thread(Rg)		
		1.4 g/kg	5 %r.H.	Volume flow	2.106 m³/h	Flow 1"	Return 1"	
		Heat output	48.3 kW	Pressure loss	3.1 kPa	Tubes material	Cu	
		CNet cross-section	1.7 m/s	Nominal pressure PN	16 bar	Fin material	Al	

Humidifier									
Manufacturer	Mountair	Air inlet	30.0 °C	Humidification	45.0 kg/h	Supply pre-pressure	4-5 bar	Accessories	15
Type	Humidos low pressure	1.4 g/kg	5.0 %r.H.	Nozzle pressure	4 bar	Water quality of inlet water:	Condensate drip tray V2A, AISI304		
		Air outlet	17.4 °C	Number of nozzles	17 (3 l/h, 60°)	Carbonate hardness	<3 °fH	Condensate drain nozzle, 1¼"	
		6.5 g/kg	49.0 %r.H.	Pump	kW A	PH value	min. 7 max. 8	Gradient condensate tray: 2%	
		Difference	5.1 g/kg		V	Conductance	min. 5 µS/cm	signal 0-10V	
							max. 20 µS/cm	inspection glass	

Oxyv vap (post-evaporation unit)	Frame material	V2A(AISI304)	Fin material	20
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Atomising humidifier									
Manufacturer	Mountair	Air inlet	40.0 °C	Humidification	111.0 kg/h	Supply pre-pressure	4-5 bar	Accessories	20
Type	Humidos Low-Pressure	1.4 g/kg	2.8 %r.H.	Nozzle pressure	4.5 bar	Water quality of inlet water:	Condensate drip tray V2A, AISI304		
		Air outlet	23.0 °C	Number of nozzles	23	Carbonate hardness	<3 °fH	Condensate drain nozzle, 1½"	
		8.3 g/kg	45.0 %r.H.	Osmosis:	on site	PH value	min. 7 max. 8	Gradient condensate tray: 2%	
		Difference	6.9 g/kg	Pump:	on site	Conductance	min. 5 µS/cm	Switch cabinet 400x500x210mm	
							max. 20 µS/cm		

Oxycom post-evaporation unit	Frame material	Untreated aluminium	15
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Low-pressure humidifier									
Manufacturer	Mountair	Air inlet	38.5 °C	Humidification	604.0 kg/h	Supply pre-pressure	4 bar	Accessories	15
Type	Humidos low pressure	0.9 g/kg	2.0 %r.F.	Nozzle pressure	4 bar	Water quality of inlet water:	Interior panels V2A, AISI304		
		Air outlet	20.9 °C	Number of nozzles	73	Carbonate hardness	<3 °fH	Condensate drain nozzle, bottom 1½"	
		8.1 g/kg	50.0 %r.F.	Humidifier without pump		PH value	min. 7 max. 8	Gradient condensate tray: 2%	
		Difference	7.2 g/kg	Flow pressure from osmosis unit		Conductance	min. 5 µS/cm	Switch cabinet with controller attached	
							max. 20 µS/cm	6Stk. Valves fitted	

Summer, EA humidification

Adiabatic humidification									
Manufacturer	Mountair	Air inlet	26.0 °C	Humidification	52.1 kg/h	Inlet flow pressure	4-5 bar	Interior panels V2A	25
Type	Humidos-lowP.	47.0 %r.F.	10.4 g/kg			Water quality of inlet water:			
Feed water, connection 1/2" IG		Air outlet	18.0 °C			Carbonate hardness	0 °fH	Controller with control cabinet	
Nozzle type:	100.0 %r.F.	13.6 g/kg				PH value	min. 6 max. 8		
6.4 l/h at 4bar	Difference	3.2 g/kg				Conductance	min. 5 µS/cm	Cond. drip tray AISi304	
Angle 60° (9 pcs.)							max. 20 µS/cm	Cond. nozzle, bottom 1½"	

References



2023

Corden Pharma, Liestal

- SMP Purification expansion unit with 40 000 m³/h. Monobloc with CCS HR. AHU for outdoor installation with Sarnafil roof, incl. Weather protection grille with suction hood, CCS defroster, CCS HR, air cooler (no dehumidification), air heater, 2-stage filter in the SA (F7/F9), adiabatic low-pressure atomising humidifier and free-running fan.



2023

Baumer Frauenfeld, Innovation Center

- 244.1 Innovation Centre, PHE Monobloc for roof installation, air volume = 20 000 m³/h, plate exchanger HR (Hygro.), incl. IE5 fans (RQM free-running), incl. Humidifier Mountair Humidos, System: Low-pressure atomiser (atomiser nozzle holder, zone valves (continuous control), turbulence generator, tray, outlets, Oxycom post-evaporation unit, incl. humidifier controller).
- 244.2 Canteen kitchen, PHE Monobloc for roof installation, air volume SA+EA = 6420 m³/h



2023

Heiget school complex, Fehraltorf

- 5 monoblocs with a total air volume of around 43 000 m³/h including a swimming pool system:
- Swimming pool Monobloc 8300/8500 m³/h. With built-in heat pump and pool water condenser, LE, EC fan, complete regulation in control cabinet, Siemens PX-C4, field devices, electrical diagram, commissioning on site



2022

Rolex Onyx, Geneva

- Monoblocs for the new ROLEX ONYX building in Geneva. Total air volumes – around 263 000 m³/h of supply air systems, 222 000 m³/h of exhaust air systems and 189 000 m³/h of zone/post-conditioning units.
- Systems equipped with CCS HR (heat recovery) and various systems equipped with humidification systems (steam, adiabatic atomising humidifiers).



2022

Spenglerpark, Building A, Münchenstein

- 9 ventilation units with a total of around 132 000 m³/h.
- With the latest IE5 Gebhardt RQM fans.
- LA01 Main system-1, air volume = 18 500 m³/h
- LA02 Main system-2, air volume = 18 500 m³/h
- LA03 Main system-3, air volume = 12 500 m³/h
- LA04 Main system-4, air volume = 12 500 m³/h
- LA05 WC East+West, air volume = 6500 m³/h
- LA06 WC + cloakroom,
Air volume = 14 000 m³/h, aluminium PHE HR
- LA07 Auditorium, air volume = 11 000 m³/h, rotary HR
- LA08 Laboratory SA+EA, air volume = 15 000 m³/h,
▪ **CCS HR, SA humidifier**
- LA09 Stop + Movement,
Air volume = 24 000 m³/h, aluminium PHE HR



2022

DSM Campus, Building-245, Kaiseraugst

- Monoblocs for the new DSM Campus Building-245 in Kaiseraugst.
- The main unit has 4 pcs. SA-EA laboratory monoblocs with 28 000 m³/h supply air and 25 000 m³/h exhaust air for each unit. The laboratory units are equipped with CCS HR incl. a defroster, Mountair Airsol-CCS. The 4 SA systems are equipped with steam humidifiers (ESCO system, direct supply from the on-site steam network). The 4 laboratory EA systems are equipped with Mountair Humidos adiabatic atomising humidifiers for summer operation for optimised cooling recovery via the CCS system (CR in summer).
- The central office system (16 000 m³/h) is equipped with a rotary HR and humidification system.
- Other ancillary systems for air-conditioning rooms, post-treatment rooms, ancillary rooms, technical rooms and then, above all, various CCS devices (for EA) from the syn. laboratories, chemical processing rooms, solvent rooms for feeding the exhaust air energy into the overall CCS HR network.



2022

Patek Philippe

- 9 Monobloc units for buildings C and D at Patek Philippe. The units are equipped with a rotary HR or PHE HR.
- In addition, several Mountair HUMIDOS low-pressure humidifiers are used for post-treatment. Fans: latest PM-IE5 fans (Gebhardt RQM) incl. integrated inverter and EMC filter.



2022

Quartier de l'Étang ilot A1/A2

- 12 Ventilation units with PHE HR/CCS HR/rotary HR
- Total air volume of 120 000 m³/h
- Outdoor installation (roof, indoor installation (centre)



2021

Merck – Sigma Aldrich, new Labs building, Buchs

- Laboratory CCS SA and EA Monobloc
- Air volume nom. = 75 000 m³/h
- SA in quality level 2, EA in quality level 4
- Unit equipped with one 6-pack EC fan wall (6 × 12 500 m³/h), incl. Silencer, air heater, air cooler, dummy part for retrofitting a dehumidifying air cooler
- Including adiabatic supply air humidification
- Humidos low-pressure humidifier (604 kg/h, 31-level, 4-5 bar spray pressure, incl. upstream UV sterilisation)



2021

Paul Scherrer Institute, PSI, Park-innovaare

- Monoblocs for new cleanroom building
- 2 x supply air monoblocs with a capacity of 27 000 m³/h each, CCS HR, double EC fans, preheater, air cooler, dehumidifying air cooler, adiabatic atomising humidifier Mountair Humidos low-pressure and reheater air heater
- A total of 5 EA units of quality level QS4 with Heresite-coated CCS registers. Without fans – on site = plastic fans
- In addition, 2 monoblocs with a capacity of 9000 m³/h each for chemical gas rooms and circulating air.



2020

New building Heart-Neuro Centre Lake Constance

- 6 SA/EA ventilation units with a total of around 64 000 m³/h ventilate the restaurant/kitchen, wards, operating theatres, intensive care diagnostics and nursing ward areas
- In the Heart-Neuro Centre, the PHE HR and CCS HR are used



2020

Coltene, renovation of old building 2nd floor, Altstätten

- SA and EA roof unit with V = 14 000 m³/h
- SA unit with free cooling register (preconditioning), CCS HR, EC fans, air heater, air cooler (glycol), evaporator (dehumidification), condenser (reheating) and adiabatic atomising humidifier Humidos low-pressure humidifier with an output of around 111 kg/h
- EA system with integrated cooling unit, CCS HR and condenser (exhaust air heat)



2020

Swiss TPH

- Total air volume around 200 000 m³/h
- Ventilation units with CCS HR incl. Pump stations/HR controllers for laboratories, biobanks and animal housing
- Ventilation units with PHE HR/rotary HR for seminar rooms, offices, restaurants and ancillary rooms



2020

Cilag Building-26, plant conversion, Schaffhausen

- Plant refurbishment/conversion
- Adiabatic humidifier, atomising humidifier (adiabatic), nozzle rack (low-pressure system), valve block, external, Oxicom post-evaporation unit
- Humidos low pressure humidifier 133 kg/h = at nozzle pressure = 4-5 bar



2020

CUORE, Blaufahnenstrasse, Zurich

- 2 units Monobloc dry cooler
- System 1: 22 000 m³/h, 250 kW recooling capacity, Humidos low-pressure humidifier 337 kg/h
- System 2: 3400 m³/h, 36 kW recooling capacity, humidos low pressure humidifier 49 kg/h



2020

Hotel Park Inn/Radisson, Rümlang

- 3 units Plate exchanger monoblocs, 2 × 14 190 m³/h and 1 × 16 500 m³/h. Each with adiabatic EA PHE humidification for cooling recovery in summer. Humidos low-pressure humidifier, capacities 52 kg/h and 61 kg/h respectively.



2020

Palais de Rumine, Lausanne

- Circulating air Monobloc with 8000 m³/h
- Filter, EC fan, air cooler, air heater
- Humidos low pressure humidifier 45 kg/h 18



2020

Weidmann, Tenant – Host-Point

- 2 units Roof monoblocs for “Tenant Hostpoint”
- Air volume of SA and EA = 4000 m³/h
- Devices with sorption rotary HR and adiabatic SA humidification.



2019

Laboratory Dr. Risch, Crissier

- PHE Monobloc as roof unit
- Air volume 3500 m³/h with EC fans, air cooler, air heater and adiabatic supply air humidifier
- Humidos low-pressure humidifier 19 kg/h



2018

ETH Zurich, HCI, humidification and dehumidification

- Monobloc refurbishment Air volume = 80 000 m³/h
- Supply air humidifier: Humidos low pressure humidifier 649 kg/h



2018

Scintilla, St. Niklaus

- 2 units CCS SA and EA Monobloc, 40 000 m³/h
- SA humidifier: Humidos low-pressure humidifier 210 kg/h



2018

ETH Höggerberg, HCI KLI-30, Zurich

- Appliance refurbishment Monobloc, EC fans, air heaters, air coolers and adiabatic atomising humidifier
- Humidos low-pressure humidifier 649 kg/h



2018

Sitem Bern, Inselspital

- New building at Inselspital Bern



2017

GAMAG, print shop, Basel

- Rotary Monobloc with 9000 m³/h incl. Adiabatic supply air humidifier for print shop
- Humidos low pressure humidifier 37 kg/h
- Alpenklang Monobloc with 2000 m³/h

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